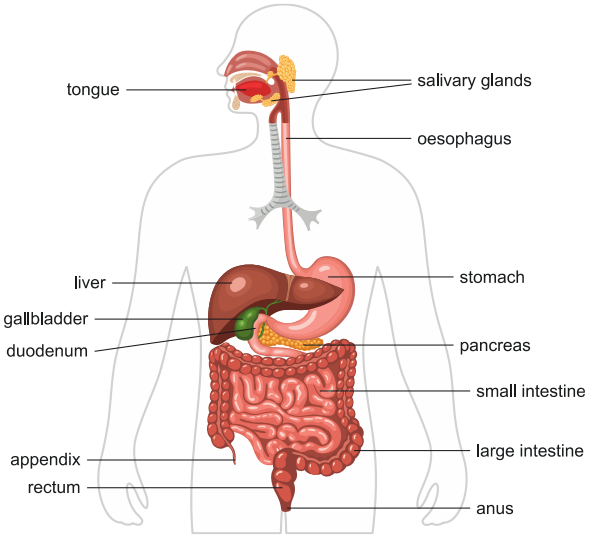
The Digestive System

1. The digestive system is an example of an organ system in which several organs work together to digest and absorb food.
2. The digestive system breaks down large, insoluble substances into small, soluble molecules that can be absorbed into the bloodstream.
3. Food passes through the following organs of the digestive system: mouth, oesophagus, stomach, (duodenum), small intestine, large intestine, and rectum.



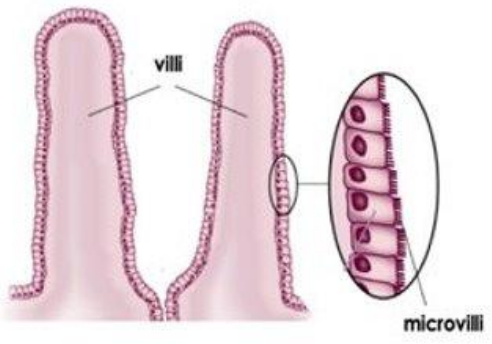
4. The pancreas is an organ which releases enzymes into the duodenum.
5. The liver is an organ which produces bile. This is stored in the gall bladder and released into the duodenum.
6. The products of digestion are absorbed in the small intestine.
7. Water is absorbed into the bloodstream from the large intestine.
8. Undigested food is stored in the rectum before being egested from the anus.

Mechanical and Chemical Digestion

9. Food is chewed in the mouth to begin the process of digestion. Chewing is a mechanical process.
10. The salivary glands secrete enzymes into the mouth which begin the process of chemical digestion.
11. The oesophagus moves food into the stomach. Rings of smooth muscle squeeze food in a mechanical process called peristalsis.
12. The muscular tissue of the stomach contracts to churn food. This is a mechanical process.
13. The stomach contains Hydrochloric Acid. This destroys micro-organisms in contaminated food. It also lowers the pH to allow enzymes to function at an optimum rate.
14. Enzymes work in the small intestine to digest any molecules that are still too large to be absorbed into the bloodstream.
15. Bile is a chemical made in the liver and stored in the gall bladder. It is alkaline to neutralise hydrochloric acid from the stomach. It also emulsifies fat to form small droplets which increases the surface area. The alkaline conditions and large surface area increase the rate of lipid digestion.

The Small Intestine

16. Small, soluble molecules are absorbed into the bloodstream in the small intestine by diffusion or active transport. The walls of the small intestine are highly folded to form villi and microvilli which increase the surface area.

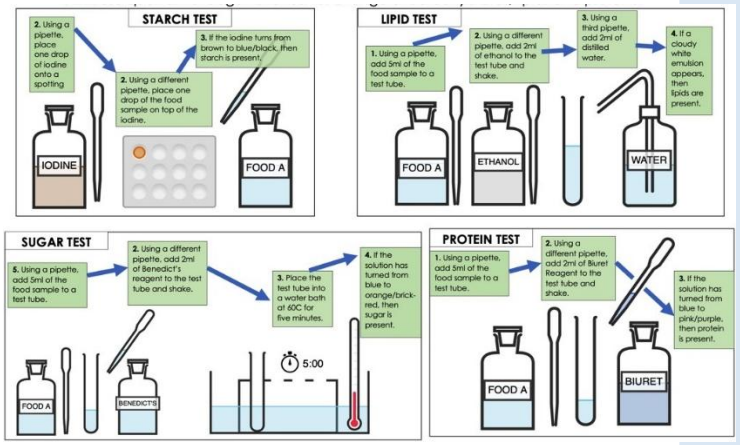


17. The small intestine is very long which increases the time for absorption.

18. Villi are specialised to absorb the products of digestion quickly by being thin which provides a short diffusion pathway. They have a good blood supply which maintains the concentration gradient.
19. The cells have many mitochondria which carry out respiration to release energy for active transport.
20. The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used in respiration. These are all examples of metabolic processes.
21. Glucose → Carbohydrates
22. Amino Acids → Proteins
23. Fatty Acids and Glycerol → Lipids

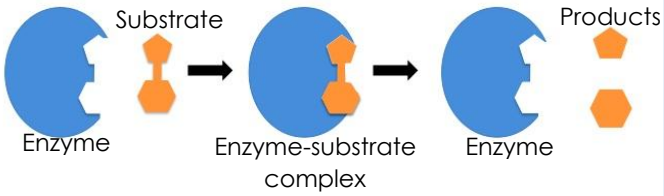
Food Tests

24. A Balanced Diet contains all the main food groups (carbohydrates, lipids, proteins), water, vitamins and minerals in the correct amounts.
25. Proteins are needed for growth and repair
26. Carbohydrates are needed as a source of energy.
27. Lipids are needed for insulation, as a source of energy and for building cells.
28. The Benedict's test is used to test for sugars. Benedict's reagent is added to a food sample and the sample is heated in a water bath. The food sample will change colour dependent on how much sugar is present. A brick-red precipitate can be seen if the sample contains a high quantity of sugar. The colour change can be represented as: Blue → Brick-red
29. The Iodine test is used to test for starch. Iodine is added to a food sample and will turn blue-black if starch is present. The colour change can be represented as: Brown → Blue-black
30. Biuret reagent is used to test for protein. Biuret reagent is added to a food sample. The food sample will turn lilac (purple) if protein is present. The colour change can be represented as: Blue → Lilac (purple)



Enzymes

31. An enzyme is a biological catalyst which speeds up reactions in living organisms.
32. Enzymes are an example of proteins. They each catalyse specific reactions in living organisms because they are folded into a highly specific shape.
33. Enzymes possess an active site that is complementary in shape to a substrate molecule.
34. A substrate molecule is a substance acted on by an enzyme.
35. When a substrate binds to the active site of an enzyme, an enzyme-substrate complex is formed.



36. The lock and key theory is used as a simplified model to explain enzyme action.
37. The Induced Fit model is another model used to describe enzyme action.
38. The induced fit model states that when a substrate binds to the active site of the enzyme, the active site and substrate change shape slightly to become complementary. This makes it easier for bonds within the substrate to break.

Digestive Enzymes

39. Many organs of the digestive system produce enzymes.
40. Large, insoluble molecules such as protein and starch must be digested so that they are small and soluble
41. Carbohydrases break down carbohydrates to simple sugars. Amylase is a carbohydrase which breaks down starch.
42. Amylase is produced in the salivary glands, pancreas and small intestine. Amylase works in the mouth and small intestine to break down starch into simple sugars (glucose).
43. Protease is produced in the stomach, pancreas and small intestine. Protease works in the stomach and small intestine to break down proteins into amino acids.
44. Lipase is produced in the pancreas and small intestine. Lipase works in the small intestine to break down fats into glycerol and fatty acids.
45. The digestion of large insoluble substances into small, soluble molecules can be represented as:
    Starch → Simple sugars (glucose)
    Protein → Amino Acids
    Lipids (fats) → Fatty Acids and Glycerol

The effect of temperature on enzyme activity

46. Enzymes are sensitive to changes in pH and temperature. Each enzyme works at an optimum temperature and pH. If the conditions change, the enzyme can denature and the shape of the active site can change.
47. Enzymes in the human body work at an optimum temperature of 37 °C.
48. At low temperatures, the rate of enzyme activity is low because substrate molecules and enzymes have low kinetic energy, meaning substrate molecules are less likely to bind with the active site of the enzyme.
49. At high temperatures, the rate of enzyme activity is low because the enzyme denatures, meaning that the active site changes shape and is no longer complementary to the shape of the substrate molecule.

The effect of pH on enzyme activity

50. At low and high pHs, the rate of enzyme activity is low because the conditions cause the enzyme to denature, meaning the shape of the active site is no longer complementary to the substrate molecule.
51. The presence of Hydrochloric Acid affects the pH of the digestive system.
52. A continuous sampling technique can be used to determine the time taken for amylase to completely digest starch solution at a range of pH values. Iodine reagent can be used to test for starch every 30 seconds. Temperature must be controlled by use of a water bath or electric heater.